**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

| | | | |
|---|---|---|---|
| Appl. No. | : | 09/618,741 | Confirmation No. : 8640 |
| Applicant | : | Thomas M. Hartnett et al. | |
| Filed | : | July 18, 2000 | |
| T.C./A.U. | : | 1731 | |
| Examiner | : | John M. Hoffmann | |
| Docket No. | : | RTN2-118PUS (formerly 07206-118001) | |

**REPLY BRIEF**

It is respectfully noted that there is no ***recognition*** in Serpek, AAPA, or Maquire that one produce aluminum oxynitride material in a drum operating at a temperature maintained constant during conversion of alumina (aluminum oxide ($Al_2O_3$)) particles, carbon particles and nitrogen into the aluminum oxynitride material; a ***recognition*** made ONLY by the Applicant. The clear teaching of the prior art is to produce aluminum oxynitride using TWO SEPARATE PROCESS, each one of the TWO SEPARATE PROCESS being at a different temperature. More particularly, the prior art teaches that one in a FIRST PROCESS react alumina, carbon, and nitrogen at a FIRST TEMPERATURE to form aluminum nitride (AlN) with some residual alumina. ONCE the formed aluminum nitride is formed, it is reacted with the residual alumina in a SECOND PROCESS at a SECOND ***HIGHER*** TEMPERATURE to form aluminum oxynitride[1]. The prior art does **not** teach or suggest that one produce aluminum oxynitride ***without*** FIRST forming aluminum nitride at a FIRST TEMPERATURE and

[1] See Maquire (col. 2, lines 54-65). Briefly: An alumina/carbon mixture is placed in an alumina crucible and, in a first process, the mixture is reacted with nitrogen at about 1550°C for about one hour whereby the temperature unstable gamma-alumina is only partially reacted with carbon and nitrogen to form both alpha-alumina and AlN. In a second process, a temperature of 1750°C or up to 2140°C is used for approximately 40 minutes whereby the alpha-alumina and AlN combine to form cubic aluminum oxynitride.

then reacting the FORMED ALUMINUM NITRIDE with alumina at a SECOND TEMPERATURE.

Applicants discovered they were able to use a single rotary furnace to ***COMPLETELY REACT ALUMINA PLUS CARBON MIXTURE IN THE PRESENCE OF NITROGEN TO FORM ALUMINUM OXYNITIDE.*** The ability to ***COMPLETELY REACT THE ALUMINA PLUS CARBON IN THE PRESENCE OF NITROGEN TO FORM ALUMINUM OXYNITIDE*** in a ***single furnace*** is not obvious in view of the prior art. Thus, it was ***not obvious*** that one can produce aluminum oxynitride in a ***single temperature process in a rotary drum*** when the ***prior art teaches*** one to perform a FIRST REACTION which takes approximately one hour to ***first completely react the ALUMINA PLUS CARBON*** form ***both*** alpha-alumina and aluminum nitride and ***then subsequently*** take ***THE FORMED*** alpha-alumina and aluminum nitride to form, in a SECOND REACTION, cubic aluminum oxynitride at a higher temperature.

In view of the two-process step teaching of the prior art to produce aluminum oxynitride it appears that the Examiner is using ***unpermitted hindsight*** in reaching his conclusion of obviousness rather than following the teachings of the prior art, i.e., a teaching of a two-step process to produce aluminum oxynitride.

Examiner's use of unpermitted hindsight is clear from the following two statements made by the Examiner:

The ***first*** statement is:

> "As to the particles being at "a" temperature, see col. 2, lines 8-9."

It is respectfully submitted that such statement, which appears in the SUMMARY OF THE INVENTION section, describes that the reaction is at a temperature in the range

of 1550°C - 1850°C does not state that the temperature is at ONLY one temperature since the reaction, described in more detail in the DETAILED DESCRIPTION SECTION beginning at column 2, line 49, is at ***temperatures*** from 1550ºC to 1850ºC, albeit more than one temperature from 1550ºC to 1850ºC, as stated therein:

> The ***aluminum oxide/carbon mixture is placed in an alumina crucible*** and is reacted in an atmosphere of flowing nitrogen at ***temperatures*** from 1550ºC to 1850ºC. for up to two hours at the maximum temperature.

Maguire then immediately describes the process in more detail stating:

> **The preferred heat treatment is in *two steps*. *In the first step,* a temperature of approximately 1550º C. is used for approximately one hour, whereby, for an appropriate ratio of alumina to carbon, the temperature unstable gamma-aluminum oxide is only partially reacted with carbon and nitrogen to form *both* alpha-aluminum oxide and aluminum nitride. *A one hour soak at 1550ºC. is sufficient to convert the proper amount of alumina to AlN*. *In the second step***, a temperature of 1750ºC. or up to the solidus temperature of aluminum oxynitride (2140ºC.), is used for approximately 40 minutes, whereby alpha-alumina and aluminum nitride combine to form cubic aluminum oxynitride. (emphasis added)

It is respectfully submitted that this assumption of a single temperature process made by the Examiner in interpreting Maguire ***comes from the teaching of the Applicant*** and ***not from Maguire***.

The ***second*** statement of the Examiner is:

"Although Maguire states that a two-step heat treatment is 'preferred', it is clear that one not need two steps/temperatures."

Why is "it clear from the above that one not need two steps/temperatures"? The Examiner in his statement assumes that Maguire is suggesting that one can perform the conversion in ***less than two steps***; however, why doesn't the Examiner consider that

Maguire is referring to a non-preferred process with ***MORE THAN two*** steps. Nothing in Maguire teaches that one can produce aluminum oxynitride material in ***one*** step. It is respectfully submitted that this assumption of less than two steps made by the Examiner in interpreting Maguire ***comes from the teaching of the Applicant*** and ***not from Maguire***.

As pointed out in the APPEAL BRIEF, the clear teaching of the prior art is that one would use a drum as Serpek at one temperature to FIRST produce AlN in a FIRST ONE OF TWO SEPARATE PROCESSES and then, AFTER PRODUCING THE AlN, produce aluminum oxynitride from the produced AlN in a SECOND PROCESS at a different temperature. Both AAPA and Maguire teach one to first produce AlN and then take that produced or formed AlN and subsequently process the produced or formed AlN with alumina to produce aluminum oxynitride. ***Applicant teaches one to do the entire conversion in a single step in a SINGLE DRUM.*** Thus, taking all the "knowledge of the prior art" (i.e., Maguire et al., U.S. Patent No. 4,686,070, AAPA, Feeco.com's webpage on Rotary Kilns and Perry "Chemical Engineers' Handbook), nothing in this prior art recognizes or suggest that aluminum oxynitride be produced in anything other than with a TWO STEP PROCESS. ***Applicants introduce alumina and carbon into one end of a rotating chamber and produce aluminum oxynitride at the other end of the chamber***.

Maguire says that this two-step process is the preferred embodiment, presumably because it provides the best result. It is reasonable to assume that if a single step process produced the same result than the single step process would be the preferred embodiment.

In his invention, in a FIRST REACTION, Maguire mixes ***alumina and carbon*** together in the appropriate fractions to convert into ***AlN and alumina*** in the proper ratio, at temperature 1. In a SECOND, SEPARATE REACTION, this mixture of ***AlN and***

***alumina*** is then heated to a higher temperature where the AlN and alumina react together to produce aluminum oxynitride.

Maguire describes a batch process, which is inherently slow. While it is obvious to one skilled in the art that FOR EACH ONE OF THE TWO REACTIONS, if the powder mixture were placed in a rotary furnace that each one of the two separate reactions would occur more rapidly[2], the simple combination of Maguire and Serpek would be to have two rotary furnaces in series, the first for the FIRST REACTION at temperature 1 and the second one for the SECOND REACTION at temperature 2. Alumina plus carbon would be inserted into the first furnace, with AlN and alumina being the end product of the first furnace to perform the FIRST REACTION. The end product of the first furnace would then be fed into the second furnace for the SECOND REACTION with aluminum oxynitride being the end product of the second furnace. A process which depends upon two rotary furnaces is not commercially viable. These furnaces are very expensive to purchase and operate.

What applicants discovered was that applicants were able to use a ***single rotary furnace*** to ***COMPLETELY REACT THE alumina PLUS CARBON MIXTURE IN THE PRESENCE OF NITROGEN TO FORM ALUMINUM OXYNITIDE***. While the examiner is correct in pointing out that we do not know for sure what the reaction process is for this powder mixture, the ability to ***COMPLETELY REACT THE ALUMINA PLUS CARBON IN THE PRESENCE OF NITROGEN TO FORM ALUMINUM OXYNITIDE*** in a ***single furnace*** is not obvious in view of the prior art. It was ***not obvious*** that one can produce aluminum oxynitride in a ***single temperature process using***

[2] While it is noted that "Fecco.com" has a date six years after Applicant's filing date, rotary furnaces have been known to reduce processing time before Applicant's invention.

***a rotary drum*** when the ***prior art teaches*** one perform a FIRST REACTION which takes approximately one hour to ***first completely react the*** ***alumina PLUS CARBON*** form *both* alpha-alumina and aluminum nitride and ***then subsequently*** take ***the formed alpha-alumina and aluminum nitride*** to form, in a SECOND REACTION, cubic aluminum oxynitride at a higher temperature .

As stated above, the prior art clearly teaches that one in a FIRST PROCESS react alumina, carbon, and nitrogen at a FIRST TEMPERATURE to form aluminum nitride. ONCE the formed aluminum nitride is formed, the FORMED aluminum nitride is reacted with alumina to form aluminum oxynitride at a SECOND TEMPERATURE. The prior art does **not** teach or suggest that one produce aluminum oxynitride ***without*** FIRST forming aluminum nitride at a FIRST TEMPERATURE and then reacting the FORMED ALUMINUM NITRIDE with alumina at a SECOND TEMPERATURE

Thus, applicants process is simpler, greatly reduces the time to produce, and hence reduces the cost and price of, aluminum oxynitride compared with the two-temperature step taught by the prior art wherein one first produces alumina at one temperature and then converts the produced alumina into aluminum oxynitride at a different temperature.

Respectfully submitted,

Date: October 16, 2009

/richard sharkansky/

Richard M. Sharkansky Reg. No.: 25,800
Attorney for Applicants
P. O. Box 557
Mashpee, MA 02649
Telephone: (508) 477-4311
Facsimile: (508) 477-7234